An Embattled Agency

Model Research. The National Advisory Committee for Aeronautics, 1915–1958. ALEX ROLAND. National Aeronautics and Space Administration, Washington, D.C., 1985 (available from the Superintendent of Documents, Washington, D.C.). In two volumes. xxx, 770 pp., illus., + index. $26. The NASA History Series. NASA SP-4103.

For those who like their history in didactic doses, the story of the National Advisory Committee for Aeronautics (NACA), the precursor to NASA, provides an important lesson: An independent government research agency can make significant contributions to science, but any achievement will occur in an environment of bureaucratic infighting, rivalry with other government agencies, and political intrigue in which research often seems less important than organizational survival.

Alex Roland, a historian of technology, traces the history of NACA from its inception in 1915 to its demise when it was subsumed into NASA in 1958. During these years NACA developed an international reputation as the most advanced and productive research establishment working in aeronautics. Its technical achievements in aerodynamics, particularly its work on cowling, the low-drag air foil, the transonic wind tunnel, and the X-series aircraft, led many scientists to see the agency as an ideal model for government research agencies. Indeed, at the outbreak of World War II Vannevar Bush modeled the National Defense Research Committee on NACA, and later he proposed, unsuccessfully, to structure the National Science Foundation on NACA principles. In the 1970's, many leaders in the field of aeronautics spoke of reviving NACA to handle government-sponsored research and development in civil aviation.

For Roland, the history of NACA is not just a chronicle of technical mileposts but a story of politics and personality. Though he does not denigrate the technical accomplishments of the agency, he presents a harsher side of its history. He spends the first volume of his study on NACA's political and institutional history, saving the administrative and technical side for the second volume, which is an edited collection of primary documents.

Drawing extensively on the files of the agency, Roland portrays NACA as embattled throughout its history. Lacking a natural constituency of its own and increasingly concerned with its own survival, NACA came to exaggerate its successes while assuming credit for achievements of others. To justify its existence as an independent scientific research organization operating with a separate administrative budget, NACA deliberately courted industry and military support. As a result, it relinquished its role as a real innovator and conduit for aeronautical research and instead became a service organization for the aviation industry and the military. This deference to its clients and self-promotion, Roland argues, influenced NACA's style and the content of its research.

The founders of NACA envisioned more for the agency. During an era when progressive thinkers believed that scientific research should be separated from politics NACA was established by Congress as an independent advisory committee charged with establishing a national aeronautical laboratory. Politics proved to be impossible to avoid, however.

At the very outset NACA became embroiled in a controversy over its role in arranging a cross-licensing agreement among aircraft manufacturers, fashioned along the lines of an agreement reached earlier in the automobile industry. When the courts ruled that the cross-licensing agreement in the automobile industry was illegal, NACA appeared to many as a tool of the "aircraft trust." Roland shows that these charges were unfair and that the agency scrupulously avoided conflict of interest with business during these early years, but such charges would nonetheless continue to appear throughout its history.

Following World War I, NACA became further involved in political battles over the creation of a separate air force, the establishment of a central aeronautical board, and federal regulation of civil aviation. Only when NACA decided to maintain neutrality on these issues would it devote full time to research. Under the guidance of an eccentric German scientist, Max Munk, a variable-density wind tunnel was erected that allowed scientists to explore problems of flight. Munk's resignation marked a turning point in the agency's history. Now experiment replaced theory and engineers took over from the scientists. Moreover, by building the wind tunnel, Roland observes, NACA focused most of its research on problems of applied aerodynamics and ignored other issues of flight. In this way, Roland concludes, the tools of research often determine the research agenda. Still, in the decade in question NACA made its most important contributions to aeronautics, winning its first Collier trophy for its work on cowling.

The Great Depression and cutbacks in federal spending forced NACA to establish closer relations with the military and private industry. The costs proved to be high. The agency seemed to lose its ability for self-evaluation, and its research agenda was no longer clear. Furthermore, during these years prior to World War II, NACA fell behind in aeronautical research. Its refusal to undertake engine research left the field of jet propulsion to others, particularly the Germans, and, more important, cost it the confidence of the military.

After the war the agency seemed on the way to regaining its reputation, as evidenced in its work on X-series aircraft, but appropriation cuts in the Eisenhower administration further pushed it into alliance with industry, to such an extent that Roland describes the agency as doing little more than "housekeeping for industry."

By 1958, NACA no longer stood as an autonomous, premier research institution. The launching of Sputnik by the Soviet Union in 1957 brought its final demise. Under the chairmanship of James Doolittle NACA made a concerted bid to become a national space laboratory, but the creation of the National Aeronautics and Space Agency meant its disbanding. NASA was to be headed by an administrator appointed by the president and confirmed by the Senate. An advisory board was established, but, unlike the NACA board, it could only advise. Furthermore, NASA was to contract up to 90 percent of its budget with private industry.

Roland makes a strong and persuasive case against independent organization as a model for government research. A closer integration of political history with consideration of the technical work of NACA could have made for a richer history, but the central point of his study is well presented. Roland shows that an independent agency, lacking political support, tends to evolve into an agency that will relinquish its independence for the sake of ensuring industry and military support. An agency such as NASA, headed by a presidential appointee, not troubled by a strong advisory committee, and having the power to contract its work through private industry, develops a natural power base. Scientists and engineers who remain naturally suspicious of politics will question Roland's conclusions. Roland, however, is no apologist for current relations between science

and the corporate-military complex. Yet he shows the inability of a government research agency to remain innovative unless it is guaranteed political support. Independent government agencies are not models for research because they prove to be too dependent on outside interests. In making this observation, Roland points to a central paradox of scientific research in the Cold War era.

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Alternatives in the Workplace

Beyond Mechanization. Work and Technology in a Postindustrial Age. LARRY HIRSCHHORN. MIT Press, Cambridge, Mass., 1984. xii, 187 pp. $17.50.

About 100 million people work for wages in the United States, spending about 200 billion hours annually on their jobs. Aside from personal convenience or monetary rewards jobs differ in their psychological rewards, some being regimented and limited in scope and others being more flexible and autonomous and providing room for personal expression and growth. Jobs are not shaped entirely by technological demands or by economic imperatives. Ways of organizing work so that it offers the best rather than the worst of possibilities for the workers are important to workers and to humanistic technologists.

Since the 1930's industrial psychologists have developed several strategies that promise the elusive mix of cheerful workers and maximal productivity. One important approach, sociotechnical design, is the subject of *Beyond Mechanization*. Hirschhorn shares the common assumption of sociotechnical analysts that managers and workers can simultaneously benefit from workplace organizations that have certain properties. He stays within the sociotechnical tradition by emphasizing four features of sociotechnical job design: workers are trained in stages to do all the tasks assigned to their group; salaries increase as workers learn more skills; work groups take responsibility for the quality of their work; and work groups allocate people to tasks flexibly.

Beyond Mechanization is an engaging introduction to the basic concepts underlying sociotechnical designs and some of the dilemmas associated with them. Hirschhorn contrasts the assumptions underlying mechanized work organizations with those of sociotechnical approaches. His central theme is that feedback control systems *require* sociotechnical approaches for effective work as well as for good jobs. He views the control systems of capital-intensive continuous-process plants, which produce products like steel, plastics, cement, chemicals, and electric power, as exemplars of the key principles of "postindustrial work systems."

Some of these systems have been subject to dramatic system failures whereas others seem to work well. Hirschhorn attributes system failures to two causes: control system designs that maximize automation and take people "out of the loop" and work systems that do not adequately integrate sophisticated training with day-to-day work. He argues his case by examining the problems at Three Mile Island, adding useful detail from his own studies of several organizations that have implemented sociotechnical work systems. The book provides an easily accessible tour of work arrangements with complex control systems. It will appeal to a scientific audience because of its reliance on systems theory, its enthusiasm for advanced technologies, its subtle technological determinism, and its focus on ways to make routine jobs opportunities for continuing education. It is an important argument for taking the creative opportunities of work life seriously rather than letting the shape of work be a byproduct of technologies.

Unfortunately, the book suffers from some major problems. First, Hirschhorn uncritically accepts common sociotechnical categories for characterizing work life and the ways organizations behave. Sociotechnical designs raise productivity by having workers labor more intensively or by reducing staff size—often by 20 to 30 percent through flexible job assignments. With large savings in staff sizes, increased quality, and lower absenteeism and turnover, managers can afford significant pay raises for those who remain employed. Careful reviews of the sociotechnical literature have shown that workers are most attracted to these new arrangements when their increased work and learning are both rewarded with higher pay. Hirschhorn does not examine the extent to which workers are attracted to sociotechnically designed jobs because of higher pay rather than because of new learning, team spirit, status, or enhanced productivity. Nor does he consider whether workers are eager to control elements of work life that are not delegated to them in sociotechnical designs, such as pay scales, the rate of technological innovation, and working hours. These questions must be addressed in any analysis that promotes sociotechnical systems as a general work reform.

Second, the subtitle and general argumentation of the book tease us with a set of concepts that promise to help us understand a broad and varied world of work. Hirschhorn's analysis, however, focuses upon the control rooms of continuous-process plants and pays little attention to assembly lines, even though they have been the subject of extensive sociotechnical experiments. He emphasizes feedback control systems as the new workplace technology, as if every workplace should be designed like a chemical refinery or a power plant.

More seriously, "postindustrial" describes a society in which service organizations—restaurants, banks, schools, medical clinics, and the like—serve as a primary source of employment. Such organizations are usually labor-intensive and their wages are often lower than those in other economic sectors. Hirschhorn does not consider how his ideas about technology and work might be applied to them. Flexible work groups could run a fast food restaurant or perhaps sections of a hospital, but difficulties multiply when the work groups include mixtures of professionals and semiprofessionals—doctors, nurses, and technicians or faculty and graduate students. The workplace democracy that is easiest among peers is much tougher to bring to stratified organizations. Longer training periods make cross-training difficult, and the more advantaged professionals are likely to resist significant differentials of pay and status. Evidence for claims such as Hirschhorn makes for sociotechnical job design should come from studies of more diverse workplaces.

Third, Hirschhorn ignores the social and economic conditions in which sociotechnical plants have thrived. He mentions that 500 firms have implemented some kind of sociotechnical work arrangement. Most of these plants are relatively small, are located in rural areas, and are not unionized (although sociotechnical design was stimulated by research in Britain and Norway, which have relatively strong labor movements). Moreover, sociotechnical designs have been most readily adopted under the special conditions of continuous-process industries, where a bad chemical batch or a power blackout costs far more than the savings that can be achieved through